plankton and the remaining flora and fauna of our waters lies in the fact that all the organisms which compose it are free-floating during the greater part of their life. Practically all the pelagic plants belong to the group of the algæ, and their minute size, of course, suits them well to a floating existence. A certain number of them are motile (*e.g.* Volvox, Gonium, Pandorina, &c.), and these are able actively to maintain themselves in their position in the water; but the large majority are non-motile, and all these forms are slightly heavier than water, and consequently tend to sink; they develop diverse mechanisms, by means of which their power of flotation is increased. The most important of these are:—assumption of a flat plate-like shape (Pediastrum, Merismopedia, many Desmids); development of numerous delicate processes from the body of the plant (Stephanodiscus, Richteriella); arrangement of the individuals of a colony in a more or less stellate manner (Asterionella, some Tabellarias); assumption of a delicate acicular shape (Synedra); formation of fat in the cell (many Diatoms and Cyanophyceæ), and so on.

In spite of these adaptations, however, most of the non-motile organisms of the plankton sink to the bottom of the containing vessel in the space of a few minutes after they have been collected. How is it that this does not happen in nature? It has been suggested that the continuous currents in the water, due to the wind and other causes, help to buoy up the organisms of the plankton; but it is of course also possible that in collecting such delicate forms they are damaged in some way or other so as to deprive them of that power of floating which suits them so well to their natural habitat. An interesting point connected with the development of the diverse floating mechanisms is that in some plants they have been found to be far more strongly developed in the summer than in the winter forms; this is, undoubtedly, in some way connected with the lower specific gravity of the water in summer, although the exact relation is not yet quite evident.

If the plankton of any piece of water is examined from week to week or month to month, we find not only astonishing variations in the quantity of organisms present, but also very marked differences in the specific constitution of the pelagic life. The quantity of the plankton is generally very much less in the winter than in the summer months, and the organisms composing it are quite different in the two seasons. Thus in the Thames there are four well marked annual phases, each characterised by its own peculiar plankton. This periodicity exhibited by the pelagic life stands in close relation to the external seasonal changes; some of the forms prefer cold, others warm water, and consequently they flourish in those seasons which are most to their liking. Some plants are particularly sensitive, and consequently only put in an appearance for a very short space of time each year. During their period of absence from the plankton these organisms persist as resting spores in the mud at the bottom of the piece of water; when favourable conditions return the spores germinate, giving rise to a new generation of pelagic organisms, which by their prolific division are able to dominate completely a piece of water in a few days' time.

The pelagic plants form the food of the animal plankton; these, again, are devoured by their larger brethren, which are the main source of nutrition for the smaller fishes. The larger fish are mostly carnivorous, feeding on smaller individuals of their kind. The organic matter of the pelagic plants thus gradually travels from one organism to another until it comes to form part of the body of the large aquatic animals; it passes through a series of incarnations before being returned to the water in the form of excrements or products of decay of dead animal and vegetable bodies. This organic matter is built up by the pelagic plants from simple inorganic salts and from carbon dioxide dissolved in the water, and these latter substances are thus changed into a form which makes them available to the aquatic fauna. All the organisms of the latter, as, indeed, all the animals of the world, are ultimately herbivorous. Without some kind of plant growth a piece of water must remain a lifeless, dead mass, unpopulated, and a thing apart from the living world around it. The presence of vegetation immediately transforms it into a throbbing universe, full of energetic life, exhibiting complex inter-relationships, and connects it with the remaining parts of our universe. The most important element of the vegetation from this point of view, however, is the phyto-plankton, and a piece of water with plenty of pelagic plants is sure to form a good breeding-place for fish and other aquatic animals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The report of the committee of the school of geography for 1905 shows that the school now holds a strong position in the University, and is doing valuable work in encouraging the study of geography and surveying, and in providing special courses of geographical lectures suited to the requirements of the different final honour schools. Both the lectures and practical instruction were well attended throughout the year, although there were only a few candidates for the diploma. This year, in addition to the ordinary work during term, a special course lasting three weeks, specially suited to those who are engaged in teaching, is being arranged for August. The instruction will be both practical and theoretical, and there ought to be no lack of support for so useful an innovation.

CAMBRIDGE.—The forestry committee having been commissioned to submit a scheme of study and examination for the diploma in forestry, recommends that the Senate approve the following:—Candidates, before receiving the diploma in forestry, shall be required to produce evidence that they have (1) passed (or obtained exemption from) the Previous examination, together with the additional subjects; (2) satisfied the examiners in physics, chemistry, geology, and botany, either in part i. of the examination for the diploma in agriculture, or in that examination in combination with the Natural Sciences Tripos, part i., or in some other examination or examinations approved by the committee; (3) diligently attended courses of instruction in forest botany, in entomology, in forestry, in forest mensuration, surveying, and engineering, and such other courses in related subjects as may from time to time be approved by the committee; (4) attended for a time equivalent to one academical year courses of instruction in practical forestry approved by the committee; (5) obtained a certificate of proficiency in practical forestry approved by the committee; (6) passed the examination for the diploma; (7) been admitted to a degree in the University.

The general board of studies has approved for the degree of Doctor in Science Mr. G. H. F. Nuttall, Christ's College.

The general board of studies also recommends that it be authorised to appoint, subject to confirmation by the special board for medicine, Mr. G. H. F. Nuttall to be reader in hygiene in connection with the special board for medicine; that the university lectureship in bacteriology and preventive medicine terminate on his appointment as reader; and that the readership terminate with the tenure of office of Mr. Nuttall.

DR. W. A. THORNTON has been appointed to the newly-created professorship of electrical engineering at Armstrong College, Newcastle.

ACCORDING to a message from Wolfville, Nova Scotia, Mr. Carnegie has promised to the Acadia University 6000*l.* for a new science building as soon as 20,000*l.* has been raised for a forward movement now in progress. Of this sum nearly half is already in hand, and the rest is definitely promised.

THE council and principal of the Bedford College for Women will hold the usual reception at the college on Commemoration Day, May 9, after the presentations for degrees at the University of London. The Pfeiffer entrance scholarship in science, tenable for three years, and of the annual value of 48*l.*, will be offered for competition in June next.

AT the annual dinner of the students of the Camborne Mining School, held in Camborne on March 10, the prin-

cipal, Mr. J. J. Beringer, in reviewing the growth of the school for the past ten years, made some remarks upon the recent report of the departmental committee on the Royal College of Science. He pointed out that while the fellows of the faculty of mining and metallurgy may be only capable of being produced and fully nourished to maturity in the new institution, yet the general practitioners would still find their way to Camborne for their training. The chairman of the school committee, Mr. C. V. Thomas, remarked that though encouragement was given by the Government and the County Council, sufficient material assistance had always been wanting, and plans for extensions were crippled for want of funds.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"A Biometrical Study of Conjugation in Paramæcium." By Dr. Raymond **Pearl.** Communicated by Prof. Karl Pearson, F.R.S.

The purpose of this investigation was to determine whether any sensible differentiation exists between the conjugating and non-conjugating members of a population of the common ciliate infusorian *Paramaecium caudatum*, and to what degree structurally similar individuals tend to pair together in conjugation. The characters principally studied were length and greatest breadth of the body, and the shape of the organism as measured by the length-breadth index. The material used covered a considerable range of cultural conditions. It was found that there is a very considerable differentiation between conjugant and non-conjugant individuals. In respect to the absolute size characters (length and breadth of body), the differences between the means for the two groups of individuals amounted to from 10 per cent. to 20 per cent. of the mean size of the larger (non-conjugant) individuals. Not only are conjugants absolutely smaller than non-conjugants, but they are also sensibly differentiated in shape. Further, they are much less variable, and less highly correlated. There is a strongly marked tendency for like to pair with like in the conjugation of Paramæcium. The coefficients of correlation measuring homogamy in conjugation, are relatively very high, both for direct and cross assortative pairing, in all the characters examined. By an experimental study of random pairings it was shown that this homogamy in conjugation is due to a real assorting and pairing of like with like, and not a spurious effect of local differentiation in the culture. Further, by comparing records obtained from recently united pairs of conjugants with similar records from pairs about to separate, it was shown that the results cannot be due to any process of equalisation in size during the process of conjugation itself. The probable manner in which the homogamic pairing is brought about is discussed, and it is shown that the results are easily explicable on the basis of known facts regarding the behaviour of the organism. It is pointed out that the demonstration of the existence of a relatively fixed "conjugant type" has a direct bearing on current views as to the theoretical significance of protozoan methods of reproduction. The importance of getting positive evidence that a sensible degree of homogamy actually exists among organisms living under natural conditions has been many times emphasised by writers on evolution. The present work brings forward such evidence for a single organism standing low in the scale of organisation.

January 18.—"A Case of Regeneration in Polychæte Worms." By Arnold T. **Watson.** Communicated by Prof. C. S. Sherrington, F.R.S.

January 25.—"On the Overstraining of Iron by Tension and Compression." By Dr. James **Muir.** Communicated by Prof. A. Gray, F.R.S.

The behaviour of mild steel under compression is investigated. Compression stress-strain curves are usually shown very much rounded at the yield-point. In this paper a specimen of steel is shown to have obeyed Hooke's law until abrupt permanent shortening occurred at the stress of 21½ tons per square inch. At this stress the reading on a Ewing "compression extensometer" altered from 241 to 2900 without increase of load. This permanent shortening at the compression yield-point was found to be practically equal to the extension at the tension yield-point of the same material. A second compression test made on the same specimen, after recovery from the compressional overstrain, showed that the compression yield-point had been raised by a step of 4 tons per square inch. This was approximately the step by which the tension yield-point of the material could be raised by tensile overstrain.

Experiments were further made to investigate the behaviour under compression of steel which had previously been subjected to tensile overstrain. The experiments seem to indicate that there are two distinct causes contributing to the phenomenon of hardening by tensile overstrain:—(1) the overstraining itself—the actual stretching of the material—seems to harden the material equally as regards both resistance to tension and to compression; while (2) the process of recovery from tensile overstrain, which seems to bring into existence an internal stress, raises the tension yield-point by a definite step above the overstraining stress, but seems to lower the compression yield-point by approximately an equal amount below the overstraining stress. For example, a specimen subjected to a series of tension tests in which the loading is carried just beyond the yield-point (recovery from overstrain being effected between each test) might exhibit yield-points at 20, 25, 30, 35, and 40 tons per square inch. The corresponding compression yield-points should probably occur at about 20, 15, 20, 25, and 30 tons per square inch. This conjecture can scarcely be said to have been fully established, further research being necessary; but it is shown that steel may be hardened by tensile overstrain to resist higher stresses both in tension and in compression, although material so hardened always withstands a greater stress in tension than in compression.

February 8.—"Polarisation in Secondary Röntgen Radiation." By Dr. C. G. **Barkla.** Communicated by Prof. J. J. Thomson, F.R.S.

In a previous paper the author gave an account of experiments which demonstrated the partial polarisation of a beam of X-rays proceeding from the anti-kathode of an X-ray focus tube. The secondary radiation from substances of low atomic weight placed in the primary beam, however, varied in intensity in the two principal directions by not more than about 20 per cent.

The experiments described in this paper were made on the secondary radiation proceeding from a substance of low atomic weight, for, according to the theory given, the radiation proceeding in a direction perpendicular to that of propagation of the primary should be almost completely polarised.

The method was similar to that used in previous experiments, the intensity of tertiary radiation from a light substance placed in the secondary beam being studied by means of electroscopes, shielded from the direct primary and secondary radiations.

The principal experimental difficulties were due to the weakness of the tertiary beams.

Carbon was chosen as the radiating substance because the energy of secondary radiation from substances of low atomic weight had been found to be proportional merely to the quantity of matter passed through by a primary of given intensity, and as absorption diminishes with the atomic weight, the lower the atomic weight the greater is the energy of secondary radiation proceeding from thick plates exposed to a given primary.

A large mass of carbon was placed in the primary beam, and the horizontal secondary beam proceeding from this in a direction perpendicular to that of propagation of the primary was studied. In it was placed a second mass of carbon, and two electroscopes were situated to receive tertiary rays proceeding in horizontal and vertical directions. As the X-ray tube was turned round the axis of the secondary beam, the intensities of tertiary radiation in the two directions changed, one increasing to a maximum while the other decreased to a minimum.

It was found that the horizontal tertiary reached a maximum and the vertical a minimum when the primary beam was horizontal, and that the conditions were reversed when the primary was turned through a right-angle.